painandpsa.org

Pain & Procedural Sedation in Acute Care. Reuben Strayer, Sergey Motov, & Lewis Nelson, eds.

Pain in the Polytrauma Patient

Christopher Hicks, MD

Emergency Physician, Trauma Team Leader

St. Michael's Hospital

Education Research Scientist, Li Ka Shing Knowledge Institute

Assistant Professor, Department of Medicine

University of Toronto

hicksc@smh.ca

@HumanFact0rz

Andrew Petrosoniak, MD

Emergency Physician, Trauma Team Leader

St. Michael's Hospital

Assistant Professor, Department of Medicine

University of Toronto

petrosoniaka@smh.ca

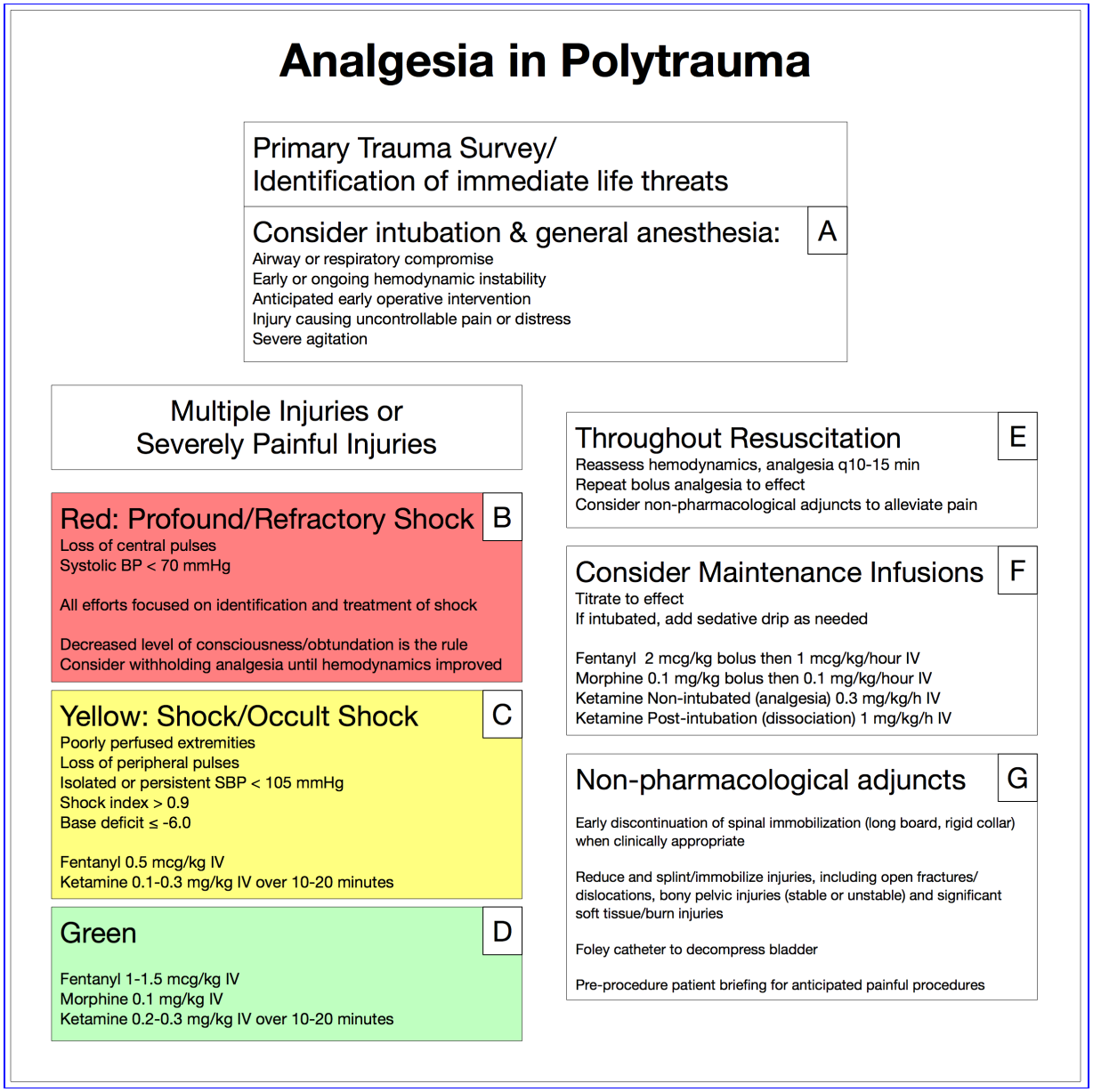
@petrosoniak

Background

Major trauma or polytrauma is defined as multiple or severe life or limb-threatening injuries, or an Injury Severity Score (ISS) greater than 15. (Baker 1974) Pain or severe pain is a near universal feature of major trauma, with greater than 9 in 10 trauma patients reporting pain on initial assessment in the emergency department. (Berben 2008) Despite this, pain in the polytrauma patient is frequently under-recognized and inadequately managed. (Gueant 2011) The reasons for this include failure to adequately assess pain, failure to identify pain management as a treatment priority, and lack of familiarity with analgesic options and dosing in the hemodynamically com-

promised patient. (Berben 2011) Severe or inadequately treated acute pain is associated with a greater incidence of chronic pain and post-traumatic stress disorder following major trauma, (Woolf 2000) pulmonary complications, (Wu 2006) prolonged hospital and intensive care stays, (Liu 1995) poor functional recovery, (Trevino 2014) and needless suffering.

We present an algorithm for pain management in the polytrauma patient that divides patients into three groups: (**Figure 1**) profound or refractory shock (Condition RED), moderate or occult shock (Condition YELLOW), and the patient with normal hemodynamics (Condition GREEN), with an approach outlined for each.



General resuscitative measures. As with all critically ill or injured patients, resuscitative measures to preserve life and limb hold primacy over other therapeutic inter-

ventions. Early endotracheal intubation, general anesthesia, and mechanical ventilation should be considered in all critically ill patients as an adjunct to resuscitation, in particular if early operative intervention or ongoing hemodynamic instability is anticipated, or egress from the trauma room to a less controlled environment (diagnostic imaging or interventional radiology) is planned. Additionally, injuries causing uncontrollable pain or distress–such as a traumatic limb amputation or multiple severe orthopedic injuries–may indicate endotracheal intubation and the use of a general anesthesia-dose sedation and analgesia in order to facilitate management and limit immediate suffering. Ketamine is an outstanding analgesic as well as an induction agent; a rapid sequence intubation protocol using ketamine and rocuronium has been found to produce favorable intubating conditions in trauma patients, while minimizing the hemodynamic response to laryngoscopy and intubation. (Lyon 2015, Ballow 2012) If an increase in heart rate or blood pressure is not desired, fentanyl may be added to the rapid sequence intubation (RSI) package as a sympatholytic. For patients presenting with severe agitation (due to a painful condition or otherwise), a delayed sequence intubation approach, where the patient is first dissociated with ketamine, adequately preoxygenated by non-invasive means and subsequently paralyzed to facilitate intubation, is an option. (Weingart 2015) Following intubation, care must be taken to provide ongoing adequate analgesia and sedation, especially if rocuronium is used (refer to Box F).

Assessment of pain in the patient with multiple or severely painful injuries. All trauma patients who are alert and responsive with suspected painful injuries should have their pain assessed early in their treatment arc, and reassessed frequently. Critical illness does not mitigate the imperative to identify and treat painful conditions, but may modify the selection, dosing, and timing of analgesia delivery (refer to Boxes B-D).

Non-pharmacological adjuncts to alleviate pain. The practice of routine spinal immobilization using a long spinal board and rigid cervical collar for all trauma patients is a common and often unnecessary source of discomfort and distress without any clear evidence of benefit. (Kwan 2001) In patients with penetrating trauma, cervical spine immobilization is associated with worse outcomes and should be discontinued early in the resuscitation. (Theodore 2013) Long spinal boards are useful in some circumstances as an adjunct to extrication but should be removed as early as possible once the patient arrives in hospital. Assessable patients with blunt injuries who meet validated C-spine clearance criteria should have their collars removed as early as feasible. (Theodore 2013) Rigid immobilization using plaster or mechanical splints should be considered for all painful extremity injuries, including fractures, burns, and significant soft tissue injuries. Although a pelvic binder is typically ap-

plied to close the pelvic diameter and limit hemorrhage in patients with hemodynamically unstable pelvic injuries, a well-applied binder can also be used to stabilize and splint pelvic fractures and may limit pain caused by patient movement. In contradiction to ATLS recommendations, logrolling a patient with a known or suspected pelvic fracture can cause clot disruption and unnecessary pain, and should be avoided. (Lee 2007, Scott 2013)

Pain schemas are in part subjective, meaning perception can be modified by providing preparatory information, or encouraging awareness and self-monitoring. When painful procedures are anticipated, a pre-procedure briefing to explain the nature of the intervention and the expected outcomes can significantly alter a patient's perception of a painful stimulus. (Dar 1993, Williams 2004) This should include a short description of the nature and duration of the procedure, an estimate of the degree of discomfort anticipated, and what will be done to minimize pain.

Profound or refractory shock (Condition RED). Profound shock in trauma may be defined as the loss of central pulses or a systolic blood pressure <70 mmHg despite appropriate resuscitative measures. In the absence of obstructive causes (tension pneumothorax, pericardial tamponade), this clinical syndrome is most likely due to massive and ongoing hemorrhage, and attention should be focused on rapidly restoring circulation by way of massive transfusion and source control (usually in the operating room). All parenteral analgesics have the potential to reduce sympathetic outflow and therefore cardiac output, which may be poorly tolerated in patients with profound shock. (Dutton 2010) Therefore, we recommend that parenteral analgesia be withheld in this subset of patients until perfusion is restored, at which time the patient's pain should be rapidly reassessed. The majority of patients in profound shock will have a reduced level of consciousness and require early endotracheal intubation, which is safely accomplished with paralytic only or using non-vasodilatory induction agents such as ketamine or etomidate at reduced dosing. Unless there is immediate airway compromise or respiratory failure not overcome by non-invasive means, we advocate for aggressive resuscitation prior to sedation and/or intubation, so as to minimize the hemodynamic effects of both.

If the patient's hemodynamics stabilize following aggressive resuscitation, pain should be rapidly and systematically managed per Condition Yellow (refer to Box C).

Shock and occult shock states (Condition YELLOW). Shock may be defined as inadequate end-organ tissue perfusion, as evidenced by cool, poorly perfused extremities, loss of peripheral pulses, or altered mental status. Occult shock, defined as elevated serum lactate or abnormal base deficit, may be present in patients who lack

overt signs of hypovolemia. (Blow 1999)

For the injured patient in pain, rapid and accurate assessment of shock states and early response to volume resuscitation is relevant to analgesic selection and dosing, as the use of these agents may worsen blood pressure and tissue perfusion. (Dutton 2010) This appears to be true even for agents generally thought to preserve cardiovascular tone, such as ketamine and fentanyl. (Miller 2015)

For the purposes of analgesic dosing we recommend a threshold systolic blood pressure of less than 105 mmHg (transient or otherwise), base deficit (BD) less than or equal to -6 or Shock Index > 0.9 in addition to clinical assessment as a means of identifying shock or occult shock. Serial assessments of BD, lactate or mixed venous oxygen saturation can be used to evaluate the adequacy of resuscitation. (Regnier 2012)

When shock or occult shock is suspected, we recommend intravenous boluses of fentanyl 0.5 mcg/kg or a short infusion of ketamine 0.1-0.3 mg/kg over 10-20 minutes. Our standard approach is to administer up to three boluses of fentanyl, followed by ketamine 0.25 mg/kg over 10 minutes if adequate pain relief is not achieved. There are no controlled, head-to-head comparisons of fentanyl with other longer-acting opioid analgesics such as morphine that address which agent has the least deleterious effect on hemodynamic status. However, a short half-life and low incidence of hypoxemia and hypotension (Krauss 2011) allows for rapid and cautious titration of fentanyl to effect, making it our preferred choice for analgesia in hemodynamically compromised patients. Fentanyl may also be used as a component of sympatholytic resuscitation in trauma anesthesia, whereby improved tissue perfusion is thought to be achieved by way of early and frequent fentanyl boluses to promote vasodilation. (Dutton, 2005) It should be noted that this approach has not yet been systematically tested in human subjects.

Analgesia titration should proceed in-line with volume resuscitation, and pain needs reassessed frequently. If the hemodynamic response is favorable, maintenance infusions may be indicated to provide consistent pain relief (refer to Box F).

The normotensive trauma patient (Condition GREEN). In a patient in whom shock or major hemorrhage is suspected but not proven, or the extent and severity of injuries is unknown, we recommend analgesic approach and dosing as with Condition Yellow (refer to Box C). For the normotensive patient in pain who lack signs of both shock and occult shock, and whose injuries can be accurately assessed by a combination of clinical and radiographic means, concern regarding the potential cardiovascular effects of parenteral analgesia are lessened. Fentanyl 1 mcg/kg IV, morphine 0.1

mg/kg IV, or ketamine 0.25 mg/kg over 10 minutes are all appropriate choices, titrated to effect. Our standard approach for these patients is up to three boluses of an opioid analgesic, followed by the addition of ketamine in analgesic doses (0.25 mg/kg IV over 10 minutes, then 0.25 mg/kg/hour, titrated to effect). As these patients typically have a less immediate mandate for egress from the trauma room, we suggest thorough and systematic consideration be given to non-pharmacologic adjuncts to alleviate pain, in particular adequate reduction and splinting of all significant pelvic and extremity injuries (refer to Box C).

Maintenance infusions in intubated patients. Recently intubated unstable trauma patients require deep sedation and analgesia during their initial resuscitation. For intubated trauma patients, who have been stabilized, we recommend an "analgesia-first" approach; (Barr 2013) ketamine 1 mg/kg/h, titrated to effect, has the advantage of both dissociative anesthesia and analgesia and is an ideal choice in this circumstance. Fentanyl infusions may be administered alone or in combination with a short-acting benzodiazepine infusion (eg. midazolam 2-10 mg/h), although prolonged fentanyl infusions are associated with significant drug accumulation, (Reardon 2015) hyperalgesia, (Lyons 2015) tolerance, dependence and withdrawal. (Wanzuita 2012) Combining a low-dose ketamine infusion (0.1-0.3 mg/kg/h) with intermittent boluses of morphine or fentanyl may in part mitigate the adverse effects of opioid infusions while leveraging the sedative and analgesic advantages of both agents. (Visser 2006)

Regional analgesia

The options for regional analgesia in trauma are myriad, and this modality is likely underutilized in patients with significant thoracic or extremity trauma. Single shot techniques, continuous peripheral nerve blocks, and epidural infusions may be used alone or in combination with parenteral analgesia as part of an opioid-sparing strategy. Four of the most common and useful peripheral nerve blocks are fascia iliaca block, hand block, rib block, and posterior tibial nerve block.

Systems-based solutions

Trauma care checklists. Introducing a trauma care checklist may provide a means by which to capture frequently forgotten or poorly performed interventions, including pain management. The inclusion of checklist prompts such as, "Has the patient's pain been adequately addressed?" and "Have the necessary medications, including analgesia and sedation, been prepared for transport?" can help prevent a task-overloaded team from omitting pain management from ongoing resuscitation. (Nolan 2014, Thomassen 2014)

Order sets and pain protocols. Pain management is significantly improved in institutions with pre-established pain management protocols. (Curtis 2007, Gawthorne 2010, Haley 2016) When applied on a routine and consistent basis, a thoughtful, institutionally-derived pain protocol may improve the assessment of pain and decrease the time to analgesia in severely injured patients.

Multidisciplinary pain service. Access to a multidisciplinary pain service, including physicians, physiotherapy, occupational therapy, and rehabilitation is crucial to ensure that severe pain continues to be effectively managed beyond the initial resuscitative and operative stages of care. Most pertinent to acutely injured patients is early consideration for regional anesthesia following significant thoracic trauma, including epidural and intercostal nerve blocks. (Truitt 2011, Moon 1999) Excessive opioid analgesia in these patients is associated with respiratory depression and adverse outcomes, (Moon 1999) which may in part be mitigated by the provision of timely and effective regional analgesia.

Summary

Pain in the severely injured trauma patient is often poorly assessed and managed. Caring for the polytrauma patient presents multiple priorities and a dynamic clinical scenario that can make effective analgesia a secondary consideration. This pitfall can be avoided by using a systematic approach to pain management for all patients, regardless of injury severity. For the purpose of analgesia decision-making, we propose categorizing trauma patients based on their hemodynamic status: profound or refractory shock, shock or occult shock, or normotensive. This will facilitate an informed choice concerning the timing, dose and analgesic agent. Non-pharmacologic measures, including early discontinuation of spinal immobilization and pre-briefing for painful procedures, should be considered for all patients regardless of hemodynamic status. Finally, given the dynamic nature of trauma resuscitation, frequent reassessment of hemodynamics and pain is mandatory as part of safe and humane trauma practice.

The authors report no relevant conflicts of interest.

References

Baker SP, O'Neill B, Haddon W Jr, Long WB. The injury severity score: a method for describing patients with mul-

tiple injuries and evaluating emergency care. J Trauma. 1974 Mar;14(3):187-96.

Ballow SL, Kaups KL, Anderson S, Chang M. A standardized rapid sequence intubation protocol facilitates airway management in critically injured patients. J Trauma Acute Care Surg. 2012 Dec;73(6):1401-5.

Barr J, Fraser GL, Puntillo K, Ely EW, Gélinas C, Dasta JF, Davidson JE, Devlin JW, Kress JP, Joffe AM, Coursin DB, Herr DL, Tung A, Robinson BR, Fontaine DK, Ramsay MA, Riker RR, Sessler CN, Pun B, Skrobik Y, Jaeschke R; American College of Critical Care Medicine. Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit. Crit Care Med. 2013 Jan;41(1):263-306.

Berben SA, Meijs TH, van Dongen RT, van Vugt AB, Vloet LC, Mintjes-de Groot JJ, van Achterberg T. Pain prevalence and pain relief in trauma patients in the Accident & Emergency department. Injury. 2008 May;39(5):578-85. Epub 2007 Jul 20.

Berben SA, Schoonhoven L, Meijs TH, van Vugt AB, van Grunsven PM. Prevalence and relief of pain in trauma patients in emergency medical services. Clin J Pain. 2011 Sep;27(7):587-92.

Blow O, Magliore L, Claridge JA, Butler K, Young JS. The golden hour and the silver day: detection and correction of occult hypoperfusion within 24 hours improves outcome from major trauma. J Trauma. 1999 Nov;47(5):964-9.

Curtis KM, Henriques HF, Fanciullo G, Reynolds CM, Suber F. A fentanyl-based pain management protocol provides early analgesia for adult trauma patients. J Trauma. 2007 Oct;63(4):819-26.

Dar R, Leventhal H. Schematic processes in pain perception. Cogn Ther Res. 1993 Aug;17(4): 341-357.

Dutton RP. Damage Control Anesthesia. Int Trauma Care. 2005 Fall:197-201.

Dutton RP, McCunn M, Grissom TE. Anesthesia for trauma. In: Miller RD, ed. Miller's Anesthesia, 7th Ed. Philadelphia: Elsevier Churchill Livingstone, 2010; 2277–311.

White KE, Szumita PM, Gilboy N, Keenan HA, Arbelaez C. Implementation of a guideline for the treatment of pain, sedation, agitation and neuromuscular blockade in the mechanically ventilated adult patient in the emergency department. Open Access

Emerg Med. 2011;3:21–27.

Guéant S, Taleb A, Borel-Kühner J, Cauterman M, Raphael M, Nathan G, Ricard-Hibon A. Quality of pain management in the emergency department: results of a multicentre prospective study. Eur J Anaesthesiol. 2011 Feb;28(2):97-105.

Haley KB, Lerner EB, Guse CE, Pirrallo RG. Effect of System-Wide Interventions on the Assessment and Treatment of Pain by Emergency Medical Services Providers. Prehosp Emerg Care. 2016 Nov-Dec;20(6):752-758.

Krauss WC, Shah S, Shah S, Thomas SH. Fentanyl in the out-of-hospital setting: variables associated with hypotension and hypoxemia. J Emerg Med. 2011 Feb;40(2):182-7.

Kwan I, Bunn F, Roberts IG. Spinal immobilisation for trauma patients. Cochrane Database of Systematic Reviews 2001, Issue 2. Art. No.: CD002803.

Lee C, Porter K. The prehospital management of pelvic fractures. Emerg Med J. 2007 Feb;24(2):130-3.

Liu SS, Carpenter RL, Mackey DC, Thirlby RC, Rupp SM, Shine TS, Feinglass NG, Metzger PP, Fulmer JT, Smith SL. Effects of perioperative analgesic technique on rate of recovery after colon surgery. Anesthesiology. 1995 Oct;83(4):757-65.

Lyons PJ, Rivosecchi RM, Nery JP, Kane-Gill SL. Fentanyl-induced hyperalgesia in acute pain management. J Pain Palliat Care Pharmacother. 2015 Jun;29(2):153-60.

Miller M, Kruit N, Heldreich C, Ware S, Habig K, Reid C, Burns B. Hemodynamic Response After Rapid Sequence Induction With Ketamine in Out-of-Hospital Patients at Risk of Shock as Defined by the Shock Index. Ann Emerg Med. 2016 Aug;68(2):181-188.

Moon MR, Luchette FA, Gibson SW, Crews J, Sudarshan G, Hurst JM, Davis K Jr, Johannigman JA, Frame SB, Fischer JE. Prospective, randomized comparison of epidural versus parenteral opioid analgesia in thoracic trauma. Ann Surg. 1999 May;229(5):684-91.

Nolan B, Zakirova R, Bridge J, Nathens AB. Barriers to implementing the World Health Organization's Trauma Care Checklist: A Canadian single-center experience. J Trauma Acute Care Surg. 2014 Nov;77(5):679-683.

Reardon DP, Anger KE, Szumita PM. Pathophysiology, assessment, and management of pain in critically ill adults. Am J Health Syst Pharm. 2015 Sep 15;72(18):1531-43.

Régnier MA, Raux M, Le Manach Y, Asencio Y, Gaillard J, Devilliers C, Langeron O, Riou B. Prognostic significance of blood lactate and lactate clearance in trauma patients. Anesthesiology. 2012 Dec;117(6):1276-88.

Richard M Lyon, Zane B Perkins, Debamoy Chatterjee, David J Lockey, Malcolm Q Russell, and on behalf of Kent, Surrey & Sussex Air Ambulance Trust. Significant modification of traditional rapid sequence induction improves safety and effectiveness of pre-hospital trauma anaesthesia. Crit Care. 2015;19(1): 134. Published online 2015 Apr 1.

Scott I, Porter K, Laird C, Greaves I, Bloch M. The prehospital management of pelvic fractures: initial consensus statement. Emerg Med J. 2013 Dec;30(12):1070-2.

Theodore N, Hadley MN, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Rozzelle CJ, Ryken TC, Walters BC. Prehospital cervical spinal immobilization after trauma. Neurosurgery. 2013 Mar;72 Suppl 2:22-34

Thomassen Ø, Storesund A, Søfteland E, Brattebø G. The effects of safety checklists in medicine: a systematic review. Acta Anaesthesiol Scand. 2014 Jan;58(1):5-18.

Trevino C, Harl F, Deroon-Cassini T, Brasel K, Litwack K. Predictors of chronic pain in traumatically injured hospitalized adult patients. J Trauma Nurs. 2014 Mar-Apr;21(2):50-6.

Truitt MS, Murry J, Amos J, Lorenzo M, Mangram A, Dunn E, Moore EE. Continuous intercostal nerve blockade for rib fractures: ready for primetime? J Trauma. 2011 Dec;71(6):1548-52.

Visser E, Schug SA. The role of ketamine in pain management. Biomed Pharmacother. 2006 Aug;60(7):341-8.

Wanzuita R, Poli-de-Figueiredo LF, Pfuetzenreiter F, Cavalcanti AB, Westphal GA. Replacement of fentanyl infusion by enteral methadone decreases the weaning time from mechanical ventilation: a randomized controlled trial. Crit Care. 2012 Dec 12;16(2):R49.

Weingart SD, Trueger NS, Wong N, Scofi J, Singh N, Rudolph SS. Delayed sequence in-

tubation: a prospective observational study. Ann Emerg Med. 2015 Apr;65(4):349-55.

Williams DC, Golding J, Phillips K, Towell A. Perceived control, locus of control and preparatory information: effects on the perception of an acute pain stimulus. Pers Ind Diff. 2004 May;36(7):1681-1691.

Woolf CJ, Salter MW. Neuronal plasticity: increasing the gain in pain. Science. 2000 Jun 9;288(5472):1765-9.

Wu CL1, Sapirstein A, Herbert R, Rowlingson AJ, Michaels RK, Petrovic MA, Fleisher LA. Effect of postoperative epidural analgesia on morbidity and mortality after lung resection in Medicare patients. J Clin Anesth. 2006 Nov;18(7):515-20.

Proudly powered by WordPress